Academy for Excellence
in Engineering Education (AE3)

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Toward a Computational Cognitive Apprenticeship for Promoting Model-Based Reasoning

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1306 Everitt Laboratory

Modern science and engineering workplaces now use computational practices to aid in analyzing and designing products, processes, and systems. In light of the integration of these practices in the workplace, engineering educators continue to identify the breadth and depth of computation, data science, and modeling and simulation skills needed by the 21st Century STEM workforce. This agenda establishes an integrated, evidence-based program of research and education centered on how people develop model-based reasoning through authentic computational practices in science and engineering. Through a series of qualitative and quantitative research studies, we attempt to understand (i) How can faculty support student model-based reasoning using computational tools? and (ii) How can students develop computational adaptive expertise?

This presentation (1) provides an overview of ways in which engineering instructors have integrated computation practices as part of their undergraduate curriculum; (2) identifies the different forms of reasoning and knowledge used when students engage in these practices as they perform problem-solving; and (3) describes opportunities and challenges students have encountered when engaging in these practices. The ultimate goal is to identify pedagogies and learning strategies that can result in students' computational adaptive expertise. Lessons learned from these studies have resulted in a computational cognitive apprenticeship model that can be used as a guideline to support learners in using computation meaningfully for their learning and overcoming challenges when engaged in this complex practice.

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Dr. Alejandra J. Magana is the W.C. Furnas Professor in Enterprise Excellence in the Department of Computer and Information Technology with a courtesy appointment at the School of Engineering Education at Purdue University. She holds a B.E. in Information Systems and an M.S. in Technology, both from Tec de Monterrey, an M.S. in Educational Technology, and a Ph.D. in Engineering Education, both from Purdue University. Her research program investigates how model-based cognition in Science, Technology, Engineering, and Mathematics (STEM) can be better supported by means of educational and expert technological tools and practices such as computational and data science and modeling and simulation practices. In 2015 Dr. Magana received the National Science Foundation's Faculty Early Career Development (CAREER) Award to investigate modeling and simulation practices in undergraduate engineering education. In 2016 she was conferred the status of Purdue Faculty Scholar for being on an accelerated path toward academic distinction. Dr. Magana serves as Deputy Editor for the Journal of Engineering Education and Associate Editor for the Computer Applications in Engineering Education journal.

For more information about Dr. Magana's research, please visit:
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